UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

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Memorandum

SUBJECT: **Methamidophos**: Revised Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document. PC Code 101201; DPBarcode: D258447.

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This occupational and residential exposure chapter contains many revisions and supercedes the previous chapters submitted for this chemical F. Fort, dated 10/29/98, D250642 and K. Boyle, dated 4/20/98, D237790. Revisions reflect changes in dermal short- and intermediate-term endpoints to be used in risk assessment (NOAEL = 0.75 mg/kg/day) as stated in a Hazard Identification Assessment Review Committee (HIARC) memorandum (N. McCarroll, dated 7/28/99, D256737.). Since the first occupational and residential risk assessment for methamidophos, Bayer has submitted 3 dislodgeable foliar residue studies (DFRs) to assess postapplication exposure to agricultural workers and set restricted-entry intervals (REIs), and these are incorporated herein.

Summary

In the Registrants's 60-day RED chapter response, Bayer cited a 21 day dermal study, the DFR studies and their observations regarding interspecies variability. An addendum report on the concentration of active ingredient (ai) used for the 21-dermal study corrected the NOAEL dose to

0.75 mg/kg/day (LOAEL dose = 11.2 mg/kg/day; based on: plasma, red blood cell and brain cholinesterase inhibition) for use in short- and intermediate-term dermal exposure assessments for methamidophos. Due to use patterns of methamidophos, as with most pesticides, chronic exposure is not expected. The margin of exposure (MOE) uncertainty factor has remained 100; MOE's <100 are generally of concern. The DFR studies have been reviewed and were incorporated in this chapter for postapplication assessment. There are no registered residential uses for methamidophos, therefore no residential risk assessment/characterization was completed for this chemical. The only uses registered are for agricultural use on potatoes, cotton and special local needs (SLNs) on tomatoes in 18 states and Puerto Rico.

HED is concerned with the use of methamidophos. HED has not received any chemical-specific occupational exposure studies for methamidophos. The registrant has engineered methamidophos packaging for closed system mixing and loading. HED received no chemical-specific exposure studies for this package engineering change. Each occupational handler exposure scenario was evaluated using the Pesticide Handlers Exposure Database (PHED) Version 1.1 (August 1998).

Pesticide Handlers Exposure Database (PHED) was used to complete occupational handler exposure calculations. The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. The PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. All data used in this assessment except for; (2) aerial fixed wing applicator and (4) groundboom applicator using engineering controls, are considered high confidence data.

The anticipated use patterns and current labeling indicate 5 major occupational handler exposure scenarios based on the types of equipment and techniques that can potentially be used to make methamidophos applications. These 5 scenarios serve as the basis for the quantitative exposure risk assessment developed for occupational handlers. The 5 scenarios are: (1a) mixing/loading of liquid formulation for aerial application and chemigation (potatoes only); (1b) mixing/loading of liquid formulation for ground boom application; (2) applying sprays with a fixed-wing aircraft; (3) applying sprays with a helicopter, (4) applying sprays with groundboom equipment and (5) flagging aerial spray applications. The 5 scenarios were evaluated for exposure by considering 3 levels of protection from exposure for the worker. The levels are as follows: baseline clothing, long sleeved shirt and long pants, PPE (personal protective equipment, baseline clothing under coveralls, chemical resistant gloves, and a dust/mist respirator and finally, engineering controls which include closed system mixing and loading and enclosed cab on tractor or aircraft.

Short- and intermediate-term dermal and inhalation margins of exposure (MOEs) were combined for each scenario and each level of protection. MOEs of >100 were obtained for only scenario (4) applying sprays with groundboom with engineering controls (enclosed cab) and scenario (5) flagging for aerial application with engineering control. The combined MOEs for the remaining scenarios at the different levels of protection ranged as follows; Baseline clothing MOEs = 0.052 to 41; PPE MOEs = 8 to 58 and Engineering Control MOEs = 17 to 630.

Postapplication exposure assessment of methamidophos use on tomatoes, potatoes and cotton was calculated based on review of the three submitted DFR studies on tomatoes and potatoes. The tomato data served as surrogate dissipation rate for cotton, whether this over- or under- estimated the dissipation rate is uncertain. The studies met most of the Subdivision K of the Pesticide Assessment Guidelines and were of sufficient scientific quality for use in this risk assessment. From these studies it appears that the restricted entry intervals (REIs) will have to be increased to protect workers. The current REIs listed on labels are default values assigned in lieu of empirical data. For the current REIs of 48 to 72 hrs, the MOEs range between 4 and 20. The REIs calculated for this assessment range from 8 to 31 days (MOEs >100).

This occupational assessment was completed using the maximum use rate of 1 lb ai/acre (lb ai/A). HED assesses potential exposure to pesticides at the maximum label rate for all pesticides calculating a conservative risk assessment.

4. Occupational Exposure/Risk Characterization

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is potential exposure to handlers, such as mixers, loaders and applicators during use or to persons entering treated sites after application is complete. Methamidophos meets both criteria; it has a classification as a Category I toxicant and there is potential for exposure from agricultural uses. There are no registered residential uses for methamidophos, therefore no residential risk assessment/characterization was completed for this chemical. The only uses registered are on potatoes, cotton and SLNs on tomatoes in 18 states and Puerto Rico.

Methamidophos is a restricted use pesticide due to its acute dermal toxicity and residue effects on avian species. It can only be sold to certified applicators or persons directly under their supervision.

It should also be noted that methamidophos is one of 22 chemicals on the United Nations list of chemicals requiring prior informed consent (PIC) procedures. On this list, methamidophos is a PCU (problems under conditions of use), which are pesticides which are not banned or restricted in developed (industrialized) countries, but which have been shown to cause problems when used without the sophisticated application technologies required to mitigate risks.

a. Use Pattern/Available Product Summary for Exposure Assessment

Methamidophos products are described in this section. Additionally, available information that describes the manner in which methamidophos products are applied is provided in this section (e.g. use categories/sites, application methods and application rates).

i. End-Use Products

Methamidophos (O,S-dimethyl phosphoramidothioate) is a restricted use acaricide/insecticide registered for use in agricultural settings only. Two active labels are registered for methamidophos, both are emulsifiable concentrates with 40 percent active ingredient (ai) sold under the name Monitor® 4. An agreement between the registrants and EPA resulted in the uses of methamidophos being limited to potatoes and cotton and the FIFRA 24(c) uses on tomatoes only[1]. In addition to the use deletions, the registrants committed to implement closed mixing and loading systems for potatoes and cotton by December 1997, and for tomatoes by December 1999.

Based on a review (6/23/99) of the *Office of Pesticide Programs-Reference Files System* (REFS) there are 5 active labels and 60 state labels. One of the special local need (SLN) state labels covers methamidophos use on cabbage (FL89001300), a use canceled in the previously mentioned agreement. Since the SLN label appears active in REFs it appears in Table 1 below:

Table 1: Active Labels for Methamidophos.

Formulation	Percent Active Ingredient	EPA Regulation Number
Technical	72	3125-341; 59639-68
Intermediate	60	3125-348
Emulsifiable Concentrate	40	3125-280; 59639-56
Special Local Need (SLN; state labels)	40	AL89000800, AR81004400, AR87000700, AR89000500, AR97000400, AZ89002000, AZ93000500, CA78016300, CA78018900, CA79009600, CA79018800, CA88002000, CA98001300, DE91000200, DE92000200, FL80004600, FL89000600, FL89000700, FL89001000, FL89001100, FL89001200, FL89001300, FL89001300, FL89001400, FL89004100, FL90000300, FL92000400, FL96000300, GA86000400, GA90000100, GA90000500, GA93000700, IN79000100, IN93000300, LA83001800, LA91000800, LA91001000, LA91001100, LA91001200, LA91001600, MD91000900, MI78001600, MI93000300, MS81001400, MS81005500, MS83001300, NC89000700, NJ96001000, OH79000800, OH79001000, PR92000100, SC79001600, TN88000400, TN89000700, TN93000300, TN96000600, TX89000700, TX89000800, TX91002300, TX91001600, VA91000500, VA93000200

All products are marketed solely for occupational use. There are no products intended for sale to homeowners or for occupational use in the residential marketplace. Existing products are intended for agricultural groundboom or aerial application for all three crops and by sprinkler irrigation (i.e., chemigation) for potatoes only.

ii. Mode of Action and Targets Controlled

Methamidophos is used for control of the following pests:

- On Cotton: aphids, thrips, fleahoppers, whiteflies, beet armyworm, cabbage looper, lygus bugs and mites;

- On Potatoes: aphids cabbage looper, Colorado potato beetle, cutworms, European corn borer, flea beetles, potato tuberworm, potato leafhopper;

- On Tomatoes: western flower thrips, granulate cutworm, leaf miners, thrips, stink bugs, aphids, fruitworms, black cutworm, beet armyworm, cabbage looper, hornworms, Colorado potato beetle, variegated cutworm and tomato pinworm.

iii. Registered Use Categories

An analysis of the current labeling and available use information was completed using the *Office of Pesticide Programs- Label Use Information System* in addition to REFS.

Methamidophos is registered for use in the following occupational/agricultural scenarios:

- Field, Forage, Fiber and Vegetable Crops: potatoes, cotton and tomatoes.

iv. Application Parameters

Application parameters are generally defined by the physical nature of the use site, the physical nature of the formulation (e.g., form and packaging), by the equipment required to deliver the chemical to the use site, and by the application rate required to achieve an efficacious dose, along with seasonal limit to applications and/or preharvest interval (PHI). Table 2 contains the crops, application types and rates for methamidophos.

Table 2: Use Parameters for Methamidophos

Crop	Application Type	Application Rate, lb ai/acre	Maximum seasonal application (lb ai or application/season), PHI
Cotton	Ground or Aerial (foliar)	1 lb ai/A	50 day PHI
Potato	Ground (including chemigation) or Aerial (foliar)	1 lb ai/A	4.0 lb ai/A (3125-280), 14 day PHI
Tomato SLNs	Ground or Aerial (foliar)	0.75 to 1 lb ai/A	2 to 9 lb ai/A/yr, (every 7-10 days), 7 to 14 day PHI
			States: AL, AR, CA, DE, FL, GA, IN, LA, MD, MI, OH, NC, NJ, PR, SC, TN, TX, VA

b. Occupational Exposure/Risk Assessment

HED has determined that there is a potential for exposure in occupational settings from handling methamidophos products during the application process (i.e., mixer/loader, applicator and mixer/loader/applicator) and from entering previously treated areas As a result, risk assessments have been completed for occupational handler and postapplication scenarios.

i. Calculations/Endpoints Used in the Exposure/Risk Assessment

A series of toxicological endpoints and calculations were used to complete the handler and postapplication risk assessments. The specifics for calculating handler and postapplication exposures differ because of the way that data for each scenario are presented. As such, the endpoints and equations that have been used to calculate exposures/risks for all scenarios are presented in this section.

Toxicological Endpoints: The toxicological endpoints, the doses and the uncertainty factors that were used to complete this assessment are summarized in Table 3 below in order to provide a quick reference to the occupational handler and postapplication assessments (based on

HIARC Reports: 10/27/98 Doc. No 012921 and 5/18/99 DPBarcode D245164).

Table 3. Endpoints for Assessing Occupational Risks for Methamidophos.

<table>
<tr><th>Test</th><th>Study</th><th>Dose</th><th>Endpoint</th><th>UF</th></tr>
<tr><td>Short-term Dermal</td><td rowspan="2">21 Day Dermal Toxicity-Rat</td><td rowspan="2">NOAEL 0.75 mg/kg/day
(LOAEL 11.2 mg/kg/day)</td><td rowspan="2">Plasma, red blood cell and brain cholinesterase inhibition</td><td rowspan="2">100 for occupational exposures</td></tr>
<tr><td>Intermediate-term Dermal</td></tr>
<tr><td>Long-term Dermal[a]</td><td colspan="4">NA</td></tr>
<tr><td>Inhalation-Any Duration</td><td>90-Day Inhalation Rat</td><td>NOAEL 0.001 mg/L
(0.27 mg/kg/day)
(LOAEL of 0.005mg/L)</td><td>Plasma, red blood cell and brain cholinesterase inhibition</td><td>100 for occupational exposures</td></tr>
</table>

NA-not applicable. Due to use patterns of Methamidophos, long term exposure is considered highly unlikely and postapplication exposure minimal.
a Long-term Dermal risk assessment is not done because exposure of this duration is not expected.

The short-term inhalation NOAEL of 0.27 mg/kg/day was calculated from the inhalation endpoint of 0.001 mg/L in Wistar rats. The inhalation endpoint for short-term inhalation risks was converted to an oral equivalent dose as presented below:

$$Inhalation\ NOAEL\ (mg/kg/day) = \frac{NOAEL\ (mg/L)\ x\ RV\left(\frac{L}{hr}\right)\ x\ D\ (hr) x\ A\ x\ AF}{BW(kg)}$$

where:

RV	=	respiratory volume (mean liters of air respired per hour at rest), for Wistar Rats is 8.46 L/hr
D(hr)	=	duration of daily animal exposure (based on a 6-hour/day)
BW(kg)	=	mean body weight in kg of Wistar rat (0.187 kg) for subchronic studies
A	=	absorption - the ratio of deposition and absorption in the respiratory tract compared to absorption by the oral route, assumed to be 1
AF	=	activity factor - animal default is 1

The HIARC classified methamidophos as a "not likely" human carcinogen (10/28/98 HED Doc. No. 012921). Therefore, a cancer risk assessment is not required.

Handler Exposure/Risk: Handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure. Daily dermal and inhalation exposures, dose levels, and risks to handlers were calculated as described below. The first step is to calculate daily dermal and inhalation exposure using the following:

$$\text{Daily Dermal Exposure}\left(\frac{\text{mg ai}}{\text{day}}\right) = \text{Unit Exposure}\left(\frac{\text{mg ai}}{\text{lb ai}}\right) * \text{Rate}\left(\frac{\text{lb ai}}{\text{Acre}}\right) * \text{Daily Treated}\left(\frac{\text{Acres}}{\text{day}}\right)$$

Where:

Daily Dermal Exposure = Amount deposited on the surface of the skin that is available for dermal absorption, also referred to as potential dose (mg ai/day);
Unit Exposure = Normalized exposure value derived from February, 1998 PHED Surrogate Exposure Table, no chemical-specific handler data were available for this assessment (mg ai/pound ai applied);
Use Rate = Normalized application rate based on a logical unit treatment such as acres, a maximum value is generally used (lb ai/A); and
Daily Acres Treated = Normalized application area based on a logical unit treatment such as acres (A/day).

Daily inhalation exposures were calculated using the following:

$$\text{Daily Inhalation Exposure}\left(\frac{\text{mg ai}}{\text{day}}\right) = \text{Unit Exposure}\left(\frac{\text{ug ai}}{\text{lb ai}}\right) * \frac{1\text{ mg}}{1000\text{ ug}} * \text{Rate}\left(\frac{\text{lb ai}}{\text{acre}}\right) * \text{Daily Treated}\left(\frac{\text{Acres}}{\text{day}}\right)$$

Where:

Daily Inhalation Exposure = amount that is available for absorption, also referred to as potential dose (mg ai/day);
Unit Exposure = Normalized exposure value derived from February, 1998 PHED Surrogate Exposure Table, no chemical-specific handler data were available for this assessment (mg ai/pound ai applied);
Use Rate = Normalized application rate based on a logical unit treatment such as acres, a maximum value is generally used (lb ai/A); and
Daily Acres Treated = Normalized application area based on a logical unit treatment such as acres(A/day).

Daily dermal and inhalation doses were then calculated by normalizing the daily dermal and inhalation exposure values by body weight. For occupational handlers using methamidophos, a body weight of 70 kg (default male body weight) was used for all exposure scenarios because the toxic effects were not sex-specific.

Since the toxicity endpoint is based on a 21 day dermal study, calculation of a dermal absorption factor is not needed; absorbed dermal doses for short- and intermediate-term were calculated using the following formula:

$$\text{Potential Dermal Dose}\left(\frac{\text{mg ai}}{\text{kg/day}}\right) = \text{Daily Dermal Exposure}\left(\text{mg ai /day}\right) * \left(\frac{1}{\text{body weight (kg)}}\right)$$

Since the inhalation toxicity endpoint is based on a route specific inhalation toxicity study, there are no route-to-route adjustments for absorption. The dose for short- and intermediate-term inhalation was calculated using the following formula:

$$\textit{Daily Inhalation Dose}\left(\frac{mg\ ai}{kg/day}\right) = \textit{Daily Inhalation Exposure}\left(\frac{mg\ ai}{day}\right) x \left(\frac{1}{body\ weight\ (kg)}\right)$$

Once the route specific daily doses are calculated, the Margin of Exposures (MOEs) are calculated as follows:

$$\text{MOE} = \frac{\text{NOAEL (mg / kg / day)}}{\text{Daily Dose (mg / kg / day)}} \quad *$$

* NOAEL and the Daily Dose are for the same route of exposure (i.e. both inhalation or dermal).

Since the dermal and inhalation endpoints are the same (i.e., plasma, red blood cell and brain cholinesterase inhibition) the route specific MOEs can be combined to express a total MOE for the occupational scenario:

$$\text{MOE}_{\textit{(short and intermediate term, dermal and inhalation)}} = \frac{1}{\frac{1}{\text{MOE}\textit{dermal}} + \frac{1}{\text{MOE}\textit{inhalation}}}$$

Postapplication Exposure/Risk: HED is concerned about potential occupational postapplication exposure to methamidophos from entering treated fields or greenhouses. Given the nature of activities in agricultural fields and green houses, contact with treated areas is likely. Bayer submitted 3 dislodgeable foliar residue studies (DFRs) that address the dissipation of methamidophos in tomato and potato fields. The studies are reviewed in detail in Section 4.b.v.

The calculations used to estimate *Daily Dermal Dose* and *MOE* for the dermal postapplication scenarios are similar to those described above for the handler scenarios. The only significant differences are: (1) the manner in which the *Daily Dermal Dose* is calculated using transfer coefficient, transferable residue levels, and accounting for the dissipation of methamidophos over time; and (2) inhalation exposures were not calculated for the postapplication scenarios (i.e., *Total Daily Dose* in the *MOE* calculation only represents dose levels resulting from dermal exposures because the data reflect inhalation exposures which have been shown historically to account for a negligible percentage of the overall body burden).

Chemical-specific dislodgeable foliar residue (DFR) dissipation data were used to complete the postapplication risk assessment. Best fit transferable residue levels (i.e., dislodgeable foliar residues) were calculated based on empirical data using the equation D2-16 from *Series 875-Occupational and Residential Test Guidelines: Group B-Postapplication Exposure Monitoring Test Guidelines*. The factors for this equation were developed based on a semilog regression of actual dissipation data for methamidophos applied to potatoes and tomatoes:

$$C_{envir(t)} = C_{envir(0)} e^{PAI_{(t)} * M}$$

Where:
$C_{envir(t)}$ = transferable residue concentration (µg/cm^2) that represents the amount of residue on the surface of a contacted leaf surface that is available for dermal exposure at time (t);
$C_{envir(o)}$ = transferable residue concentration (µg/cm^2) that represents the amount of residue on the surface of a contacted leaf surface that is available for dermal exposure at time (0);
e =natural logarithms base function;
PAI_t = postapplication interval or dissipation time (e.g., DAT day); and
M = slope of line generated during linear regression of data [ln(C_{envir}) versus postapplication interval (PAI)]**.**

- Dermal Dose values on each postapplication exposure day were calculated using the following:

$$\text{Dermal Dose}\left(\frac{\text{mg ai}}{\text{kg / day}}\right) = \frac{\text{TR}[t] * \text{ Tc } * \text{ DA}\left(\frac{\%}{100}\right) * \left(\frac{\text{Hr}}{\text{Day}}\right) * \text{ 1 mg}}{\text{BW(kg) } * \text{ 1000 ug}}$$

Where:

TR = transferable residue at time (t) as defined above (μg/cm^2);
Tc = transfer coefficient or measure of the relationship of exposure to transferable residue concentrations while engaged in a specific mechanical activity or job function (cm^2/hour);
DA = dermal absorption (%);
Hr = exposure duration or hours engaged in specific mechanical activity (hrs);
BW = body weight (kg); and
Dermal Dose $_{(t)}$ = absorbed dose attributable to exposure at time (t) when engaged in a specific mechanical activity or job function (mg/kg/day).

ii. Handler Risk Assessment Assumptions and Factors

The following assumptions and factors were used in order to complete this exposure assessment:

- Average body weight of an adult handler is 70 kg because the toxic effect for short- and intermediate-term assessments is appropriate for both male and female populations based on the toxicological effect.

- Average work day interval represents an 8 hour workday (e.g., the acres treated or volume of spray solution prepared in a typical day).

- Daily acres and volumes (as appropriate) to be treated in each scenario include:
  - 80 acres for groundboom spray application; and
  - 350 acres for chemigation, and aerial applications.

- Calculations are completed at the maximum application rates for specific crops recommended by the available methamidophos labels to assess risk levels associated with the various use patterns. No use data were provided by the registrant concerning the "typical" application rates that are commonly used for methamidophos.

- Due to a lack of scenario-specific data HED often calculates unit exposure values using generic protection factors (PF) that are applied to represent various risk mitigation options (i.e., the use of Personal Protection Equipment (PPE) and engineering controls). PPE protection factors include those representing a double layer of clothing (50 percent PF), chemical resistant gloves (90 percent PF) and respiratory protection (80 percent PF) for use of a dust/mist respirator. Engineering controls are generally assigned a PF of 98 percent.

- For occupational exposure scenarios, an MOE of 100 (10x for intra-species and 10x for interspecies variability) was assigned by HIARC.

iii. Handler Exposure Data Sources

No chemical specific handler exposure data were submitted in support of the reregistration of methamidophos. Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted to the Agency in support of the reregistration of methamidophos. It is the policy of the HED to use data from the Pesticide Handlers Exposure Database (PHED) Version 1.1 to assess handler exposures for regulatory actions when chemical-specific monitoring data are not available.[2]

PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates).

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest upper arm) is categorized as normal, lognormal, or “other” (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all “other” distributions. Once selected, the central tendency values for each body part are composited into a “best fit” exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Table 13. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments.[3]

There are three basic risk mitigation approaches considered appropriate for controlling occupational exposures. These include administrative controls (such as decreasing the application rate), the use of personal protective equipment or PPE and the use of engineering controls. Occupational handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure or cancer risk. [Note: administrative controls available generally involve altering application rates for handler exposure scenarios. these are typically not utilized for completing handler exposure assessments because of the negotiation requirements with registrants.] The baseline clothing/PPE ensemble for occupational exposure scenarios is generally an individual wearing long pants. a long-sleeved shirt, no chemical resistant gloves and no respirator. The first level of mitigation generally applied is PPE. As reflected in the calculations included herein, PPE involves the use of an additional layer of clothing, chemical-resistant gloves and a respirator. The next level of mitigation considered in the risk assessment process is the use of appropriate engineering controls which, by design, attempt to eliminate the possibility of human exposure. Examples of commonly used engineering controls include closed tractor cabs, closed mixing/loading/transfer systems, and water-soluble packets.

iv. Occupational Handler Risk Assessment

HED has determined that exposure to pesticide handlers is likely during the occupational use of methamidophos in agricultural environments. The anticipated use patterns and current labeling indicate 5 major occupational exposure scenarios based on the types of equipment and techniques that can potentially by use to make methamidophos applications. These 5 scenarios serve as the basis for the quantitative exposure risk assessment developed for occupational handlers. These scenarios include:

(1a) mixing and loading of liquid formulation for aerial application and chemigation application (potatoes only);
(1b) mixing/loading of liquid formulation for groundboom applications;
(2) applying sprays with a fixed-wing aircraft;
(3) applying sprays with a helicopter;*
(4) applying sprays with groundboom equipment; and
(5) flagging aerial spray applications.

- *No chemical-specific exposure data was submitted for this scenario. PHED contains insufficient data points for rotary-winged aircraft applications therefore, aerial application in this assessment is assumed to be by fixed-wing aircraft only[4].

The risk assessment that has been completed for the occupational handler scenarios is presented in Tables 9 through 13. HED anticipates that methamidophos occupational exposures will only occur in a short-term or intermediate-term pattern. HED defines chronic exposures as use of the chemical for approximately 180 days per year and it is anticipated that methamidophos, as with other typical pesticide compounds, will not be used in this manner. [Note: Readers are cautioned to consider the merits of each exposure scenario when reviewing these tables as risk mitigation options are not universally applicable in all settings (e.g., open cab aerial applications are not considered feasible)].

Table 9 includes all of the information required to calculate MOEs such as the acres treated per day (A/day), application rate (lb ai/A) and the dermal and inhalation unit exposures for each occupational handler exposure scenario at each level of mitigation (i.e., a single layer of clothing -- long-pants and long-sleeved shirts; no chemical resistant gloves and no respiratory protection, PPE use, and engineering controls). Separate MOEs were calculated for dermal and inhalation by comparing the NOAEL assigned by HIARC to the relevant daily dose level. Since both short- and intermediate-term dermal and inhalation have the same toxicological endpoint (plasma, red blood cell and cholinesterase inhibition) the MOEs are then combined as stated in *Section 4.b.i.* As a result, only a single MOE value is presented to represent both short- and intermediate-term dermal and inhalation exposure scenarios. The uncertainty factor established by the HIARC is 100. If MOEs for any scenario exceeded 100 the risk assessment is considered protective and further mitigation is not required (i.e., the risk mitigation is not increased).

In cases where the risk assessment indicated an unacceptable level of risk at the baseline clothing scenario (i.e., MOE <100), HED applied varying levels of mitigation to each scenario until either an acceptable level of risk was attained or an exhaustive level of risk mitigation was applied and an acceptable level of risk could not be attained. Table 10 contains the baseline clothing risk assessment for the exposure scenario calculations. Tables 11 and 12 include the risk assessments that were completed for methamidophos at increasing levels of risk mitigation. As indicated above in *Section 4.b.iii*, risk mitigation options used by HED for occupational pesticide handlers include (1) the use of PPE (Personal Protective Equipment) that includes an additional layer of clothing, chemical resistant gloves, and respiratory protection; and (2) the use of appropriate engineering controls. The risk assessment completed for handlers using PPE is presented in Table 11. The risk assessment completed for handlers using engineering controls is presented in Table 12. The format of these tables is similar to Table 10. The only differences are the unit exposure values taken from Table 9 represent different levels of risk mitigation.

Table 13 summarizes the caveats and parameters specific to the data used for each exposure scenario. These caveats include descriptions of the source of the data and an assessment of the overall quality of the data. Generally, the assessment of data quality is based on the number of observations and the available quality control data. Quality control data are assessed based on grading criteria established by the PHED Task Force. Additionally, it should be noted that all calculations were completed based on current HED policies pertaining to the completion of occupational and residential exposure/risk assessments (e.g., rounding, exposure factors, and acceptable data sources).

v. Data Sources for Postapplication Risk Assessment

HED considered occupational postapplication exposure scenarios in this risk assessment. Three chemical-specific studies were submitted to support the reregistration of methamidophos that were generated to quantify dislodgeable foliar residues in various crops (i.e., tomatoes and potatoes). Along with the chemical-specific data, guidance provided in *Series 875-Occupational and Residential Test Guidelines: Group B-Postapplication Exposure Monitoring Test Guidelines* were used to complete various aspects of this risk assessment. The use of specific data sources is noted as appropriate.

The following chemical-specific studies were submitted to support the reregistration of methamidophos can be identified by the following information:

- **EPA MRID 40985203; Dissipation of Dislodgeable Methamidophos Residues from Cotton Leaves:** Submitted by Chevron Chemical Company; Study date: 9/3/85; Author G.H. Fujie;

- **EPA MRID 44685501; *Evaluation of Foliar Dislodgeable Residues of MONITOR on Tomatoes***: Submitted by Bayer Corp; Study completion date: 9/18/97; Report Date: 10/23/98; Author: G.K. Ellisor, M.S., CIH, DP Barcode: D251087;

- **EPA MRID 44685502; *Evaluation of Dislodgeable Foliar Residues on MONITOR [methamidophos] on Potatoes***: Submitted by; Bayer Corp.; Study Completion Date: 10/6/98; Report Dated:10/20/98 ; Author: Gregory K. Ellisor, CIH, DP Barcode: D251088;

- **EPA MRID 44685503; *Dissipation of Dislodgeable Foliar Methamidophos Residues from Monitor® 4 Treated Potatoes***: Submitted by Bayer Corporation; Study Completion Date: 10/23/98; Report Date 10/23/98; Author; Tommy R. Willard, PhD., American Agricultural Services, Inc., DP Barcode: D251089;

MRID 40985203 DFR study was submitted by Chevron Chemical Company (now part of Valent) was evaluated by Versar under HED supervision in 1990. Significant issues with the study are as follows:

- only one site was tested, not the required three;

- residue levels were collected for only 7 days instead of the recommended 35. At day 7 after treatment detectable levels were still found;

- QA/QC insufficient. No application rate was validated, no sprayer calibration performed, no tank mixes sampled, no field spike or storage stability samples were generated;

- only product referenced was a technical grade product, no label given for product used, no specific chemical formulation given;

- little or no information was provided regarding the specifications and calibration of each sprayer used to make applications;

- Analytical method was lacking: no field recovery data or raw data calculation sheets submitted, therefore, residue level calculations could not be verified. Daily standard curves and correlation coefficients were not presented;

- The formula resulting from the least-square regression completed by author follows: $y = be^{mx}$; b = y-intercept, 0.259248594, m = slope, -0.36343510; x =

days after treatment. The resulting dissipation using the study equation results in REIs of 4 and 8 days for early and late season scouting respectively. The predicted and the mean of the measured values are set out below for comparison. The R^2 value for the study concentrations and the predicted concentrations was 0.92. An R^2 value $\geq$0.90 implies a reasonably good correspondence between the actual data and the calculated regression.

Task/Tc	REI (days)	Study Concentration (mean)	Predicted Concentration
Early Season Scouting/1000 cm^2/hr	4	0.083	0.0606
Late Season Scouting/4000 cm^2/hr	8	study measured to day 7 only	0.0142
Day 7 values	--	0.018	0.0204

HED will not use this data for risk calculations due to the many deficiencies in the execution of the study, it is stated for comparison purposes only.

Tables 14-18 summarize the data generated in the recent studies used in the development of the postapplication risk assessment. In order to better understand the data presented in Tables 14-18, a brief summary of these studies follows.

MRID 44685501: Dislodgeable foliar residue levels of Monitor® 4 were quantified from tomato plants in three areas: Vero Beach FL; Fresno, CA; and Tifton, GA. Monitor® 4 was applied 5 times at the maximum label rate of 1.0 lb ai per acre at 7-day intervals with high-clearance, groundboom spraying equipment calibrated prior to each treatment. Field studies were conducted from mid-October to late December of 1995 in the Florida location; from late May to mid-July of 1995 in the Georgia location; and from late June to late August of 1995 in the California location. In each location, three replicate DFR samples and one blank sample were collected at the following intervals: prior to each treatment, immediately after the spray had dried (IASD), and 1, 2, 3, 5, and 7 days after each application. The IASD interval was approximately 2 hours post-application. Samples were also collected at 9, 11, 14, 21, 28, and 35 days after the final (fifth) application in each location. The residues were dislodged from the samples within 2 hours of collection. No assessment was made for handler/worker exposure in this study.

The analytical method was validated prior to the initiation of analysis. Field recovery and laboratory recovery samples were collected. No storage stability study was conducted. DFR and laboratory recovery samples collected in this study were analyzed concurrently and prior to analysis of the corresponding fortified field samples. Tank samples were also collected prior to each application in each location. All laboratory recoveries fell in the range of 70 percent to 120 percent with only one exception. Mean field recoveries were all between 70 percent and 120 percent except application 2 at concentrations of 25 and 250 µg/100ml in the Georgia location.

This study met the criteria contained in Subdivision K of the Pesticide Assessment Guidelines. Note: Use of methamidophos in Florida during winter use is not characterized as typical use in Florida, April to July is typical as stated in study. Further, no plant health or stage characterization was made in study.

MRID 44685502: Dislodgeable foliar residue levels of Monitor® 4 were quantified from potato plants in Stilwell, KS: Four applications of Monitor® 4 were performed at the maximum label rate of 1.0 lb ai per acre at 7-day intervals with groundboom spraying equipment calibrated prior to each treatment. Field studies were conducted from June to July on 1996. Potato DFR leaf-punch samples were collected using a 1-inch diameter sampler (Birkestrand Co.), based on the method of Iwata et al. Post-application DFR samples were collected: as soon as sprays dried (i.e., at 2 hours), and 1, 2, 3, 5, and 7 days for the first three applications, and for the fourth application, additional sampling occurred at 9, 11, and 14 days after application. Most recovery values exceeded 80 percent, and with exception of two which were from the highest fortification level.

This study met **most** of the criteria contained in Subdivision K of the Pesticide Assessment Guidelines and will be used in the methamidophos risk assessment. Pertinent omissions and flaws included: (1) lack of analytical method calibration curve information to establish the linearity of the method with regard to reported DFR data; (2) the field spike sample recovery data did not extend to the maximum DFR value reported in the study (i.e., 680 μg/100 ml methamidophos, uncorrected for recovery). Therefore, field recovery was not quantified at all study values. The field spike data ranged from 2.5 to 250 μg/100 ml, and the average recovery at the highest spiked concentration was 78 percent; and (3) the location chosen for this study was not in a major potato-producing area.

MRID 44685503: The stated purpose of this study was to generate dislodgeable foliar residue (DFR) data to support registration of MONITOR 4 Liquid Insecticide on potatoes. DFR samples were collected from two test plots located in major potato-producing states (i.e., Ingham county, MI and Grant county, WA) between July 23 and September 26, 1997. This study failed to meet several important quality criteria contained in the Subdivision K Pesticide Study Assessment Guidelines. Pertinent omissions and flaws included: (1) regression analysis was not performed using the recommended method of assuming lognormality and using natural logarithms of the data in the linear regression of the DFR data; and an explanation or justification was not provided for using a base 10 logarithm regression analysis; (2) lack of analytical method calibration curve information to establish the linearity of the method with regard to reported DFR data and; (3) the field spike sample recovery data did not extend to the maximum DFR value reported in the study (i.e., 845 μg/100 mls methamidophos, uncorrected for recovery). Fortified field spike samples covered a range between 2.5 and 250 μg/100 mls, and the average recovery at the highest spiked concentration ranged between 67 percent and 76 percent (mean = 72 percent).

These data were analyzed by Versar under HED supervision for use in the risk assessment by completing a semi-log regression and a pseudo-first order kinetics calculation of half-life as is described in the *Calculations* chapter (Part D, chapter 2) of the draft *Series 875-Occupational and Residential Exposure Test Guidelines, Group B-Postapplication Exposure Monitoring Test Guidelines*. Analysis of the data is summarized below in Table 4:

Table 4: Summary of DFR Study Values Submitted on Methamidophos

MRID	Location	Application Rate (lb ai/A)	Crop	R^2	Slope	C_0	Half Life
4685501	FL	1	tomato	$r^2 = 0.671$	-0.109	0.4657	6.37
	CA	1		$r^2 =0.729$	-0.229	0.2646	3.03
	GA	1		$r^2 = 0.834$	-0.242	0.5438	2.86
4685502	KS	1	potato	$r^2 = 0.904$	-0.217	0.43937	3.19
4685503	MI	1	potato	$r^2 = 0.6954$	-0.4776	0.2668	1.45
	WA			$r^2 = 0.846$	-0.2836	0.3075	2.44

Summary of Dislodgeable Foliar Residues

The submitted postapplication residue studies provide DFR data for potatoes and tomatoes. The DFR data in these studies were collected at three sites for each of these crops. Because of the absence of additional DFR data for cotton treated with methamidophos, the tomato data were used as surrogate residue values. Tomato DFR values were chosen because of the similar growing regions and conditions to cotton. Although the use of crop specific residues to estimate other types of crops introduces uncertainties in the postapplication analysis, it is believed to be more realistic than assuming a default initial residue value based on the application rate and an assumed dissipation rate per day. Default transfer coefficients (Tc, cm^2/hour) assigned by the Science Advisory Committee on Exposure were used to determine potential exposures to workers entering treated fields. The Tc values were derived by pesticide exposure assessors, based on their best judgement from their experience with the transfer coefficients used for the crops and agricultural activities in pesticide-specific assessments[4].

The transfer coefficients represent an approximation of the total leaf surface area a worker would contact over an hour when performing a task. Therefore, assignment of a Tc is dependent on the task performed, the height and the foliage of crop. The Science Advisory Committee on Exposure divided crops and activities into groups to help assess risks for postapplication field work.

The summary of the dissipation data are listed in the tables 5 and 6 below.

Table 5: Potato Dissipation Data for 3 Sites. (Calculated by Versar, pseudo non-linear regression)

Site	DFR (μg/cm^2) -- Predicted Values Based On Log Transformed Data								Half-life (days)	R^2
	0 DAT	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT		
KS	0.4839	0.3894	0.3133	0.2520	0.2028	0.1632	0.1313	0.1056	3.19	0.903
MI	0.2668	0.1655	0.1026	0.06367	0.03949	0.02449	0.01519	0.00942	1.45	0.695
WA	0.3075	0.2316	0.1744	0.1313	0.09891	0.07449	0.05619	0.04224	2.44	0.840

Table 6: Tomato Dissipation Data for 3 sites.

Site	DFR (μg/cm^2) -- Predicted Values Based On Log Transformed Data (Values in Parentheses Are Normalized Field Measured Values)								Half-life (days)	R^2
	0 DAT	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT		
FL	0.4657	0.4177	0.3746	0.3360	0.3013	0.2703	0.2424	0.2174	6.37	0.671
CA	0.2646	0.2104	0.1673	0.1331	0.1058	0.08415	0.06692	0.05322	3.03	0.720
GA	0.5438	0.4269	0.3351	0.2631	0.2065	0.1621	0.1273	0.0999	2.86	0.834

Transfer coefficients are used to translate the DFR values to activity patterns (e.g., scouting, harvesting) to estimate potential human exposure. The values assigned by the Science Advisory Committee on Exposure for dermal transfer coefficients represent conservative reliable estimates of potential exposure during the specified tasks. **These transfer coefficient defaults are in use until the Agriculture Reentry Task Force (ART) provides activity-specific data.** Table 7 presents a matrix for potential activity-specific contact rates for crops used in the postapplication assessment.

Table 7: Postapplication Potential Dermal Contact Rate and Crop Matrix.

Crop Treated (Potential for Dermal Contact)	Transfer Coefficient (cm^2/hr)[b]	Activities	Application Rate (lb ai/A)
Cotton[a]	1,000	Scouting, early season	1
	4,000	Scouting, late season	1
Tubers (potato)	10,000	Dig/harvest by Hand	1
	2,500	Sort, Pack	1
High (tomato)	10,000	Harvest, Cut/harvest, prune, transplant	1
	4,000	Stake/tie, scout, irrigate	1

a Cotton foliar treatments were assessed separately using surrogate tomato data from MRID 4486501.
b Standard values for transfer coefficients are from HED Exposure Science Advisory Council (SAC) Policy #3 dated May 7, 1998.

vi. Postapplication Risk Assessment Assumption and Factors

A series of assumptions and exposure factors served as the basis for completing the occupational risk assessment. Each assumption is detailed below on an individual bases. These include:

- The average body weight of an adult used in all assessments is 70 because the NOAEL used for the short- and intermediate-term assessments (mg/kg/day for both scenarios) is appropriate to both male and female populations based on the toxicological effect.

- Single day exposures were calculated to reflect chemical specific residue dissipation rates over time coupled with the default transfer coefficients described in Table 7.HED has calculated unit exposure values for workers using the default transfer coefficients that represent reasonable exposures for occupationally exposed populations.

- The exposure duration for worker population is 8 hours;

- Crop specific residue data are not available for all situations and climates. Therefore, the use of available data to "simulate" residues on other crops introduces uncertainties in the setting of reentry intervals. It is reasonable to believe that the residues monitored in the available studies approximate the residues on another crop or another area within a region. The extent that these residues might be an under- or over -estimate is unknown.

vii. Occupational Postapplication Risk Assessment

HED has determined postapplication exposure is likely to occur because methamidophos is applied to agricultural crops for which the cultural practices require human labor to successfully produce the crop. Some exposure scenarios of concern to HED include:

- scouting (early and late season);
- hoeing, staking crops;
- harvesting; and
- sorting crops.

HED believes that postapplication exposure due to inhalation will be minimal because of the infinite dilution one would expect outdoors. In addition, HED has no policy or method for evaluating non-dietary ingestion for an occupational population even though it could result from poor hygiene practices or smoking. As a result, given the lack of chemical-specific exposure data, only dermal exposures were evaluated for this postapplication assessment. Based on the anticipated methamidophos use patterns and current labeling, 5 major postapplication exposure scenarios were modeled using default transfer coefficients and the chemical-specific dislodgeable foliar residue dissipation data described above. These assessments were based on the guidance provided in the *Draft: series 875-Occupational and Residential Exposure Test Guidelines, Group B-Postapplication Exposure Monitoring Test Guidelines (7/24/97 version).* The scenarios assessed include:

(1a) Scouting Cotton, early season;
(1b) Scouting Cotton, late season;
(2) Harvest/dig tubers by hand;
(3) Sort, Pack tubers;
(4) Hand Harvest. cut/harvest, transplant tomatoes; and
(5) Stake/tie, scout and irrigate tomatoes.

Tables 14-18 present the results of the quantitative occupational postapplication risk assessment completed by HED. The REIs calculated by HED are based on the same dislodgeable foliar residue data and default transfer coefficients mentioned above. The REIs calculated by HED are summarized in Table 8 below:

Table 8: Summary of Calculated REIs for Methamidophos.

Task	Crop	Application Rate (lb ai/A)	REI days (state)
(1a)Scouting -early season	Cotton	1	18(All)
(1b) Scouting -late season			31(All)
(2) Harvest/dig tubers by hand	Potatoes	1	20(KS); 8(MI); 14(WA)
(3) Sort, pack Tubers			14(KS); 5(MI); 9(WA)
(4) Hand harvest, cut, transplant	Tomatoes	1	40(FL); 19(GA); 17(CA)
(5) Stake/tie, scout, irrigate			31(FL); 15(GA); 13(CA)

These REIs represent a worker entering a field with long-sleeved shirt and long pants. Postapplication risks are mitigated for crop advisors/scouts using entry restrictions, not restricted-entry intervals. Under the Worker Protection Standard for Agricultural Pesticides -- 40 CFR Part 170, crop advisors/scouts are defined as handlers, the Agency can permit such persons to enter treated areas to perform scouting tasks, provided they are using required personal protective equipment. Additionally, the crop advisor exemption allows certified or licensed crop advisors to choose appropriate protection to be used while performing crop advising tasks in treated areas for themselves and for their employees. However, the WPS exemption does not exempt crop advisors from regulation under FIFRA-Sections 3, 6, and 12, and Title 40 CFR Part 156.204(b)-Labeling in regard to risk concerns identified through reregistration or other EPA risk assessment /data evaluations processes.

c. Occupational Risk Assessment/Characterization

The risk assessment is summarized herein. Please refer to the appropriate tables as stated in text, as they are the basis for this risk assessment.

i. Handler Scenarios with Risk Concerns

The only two scenarios to obtain a combined MOE > 100 was (4) Applying spray with goundboom (MOE = 130),and (5) Flagging aerial application (MOE = 630), mitigated with engineering controls (enclosed cab). The combined MOE results for each scenario at each mitigation level are in set out in the table below:

Summary of Combined Dermal and Inhalation MOEs for Methamidophos Occupational Handler Exposure.

Exposure Scenario	Baseline Combined MOE	PPE Combined MOE	Engineering Control Combined MOE
Mixer/Loader			
(1a) Mixing/Loading Aerial/Chemigation	0.052	8	17
(1b) Mixing/Loading Groundboom	0.23	35	74
Applicator Exposure			
(2) Applying Spray with Fixed Wing Aircraft	NA	NA	29
(3) Applying Spray with Helicopter	NA	NA	NA
(4) Applying spray with Groundboom	41	58	130
Flagger Exposure			
(5) Flagging Aerial Spray Applications	13	14	630

ii. General Risk Characterization Considerations

Several issues must be considered that pertain to the quality of the assessment and when interpreting the results of the occupational handler/postapplication risk assessment. These include:

- No chemical-specific handler exposure data were submitted. As a result, all analyses were completed using surrogate exposure data from sources such as PHED V1.1. Several handler assessments were completed using "low quality" PHED data due to the lack of a more acceptable data set (see Exposure Scenario Table 13 for further details). The PHED unit exposure values range between the geometric mean and the median of the available exposure data.

- Chemical-specific dislodgeable foliar residue studies did not contain worker exposure data. Default transfer coefficients were used to estimate potential exposures and doses for workers entering treated fields for various tasks. The default transfer coefficient values are based on published empirical data and are generally considered by HED to represent reasonable estimates of dermal exposure.

- Several generic protection factors were used to calculate handler exposures. The protection factors used for clothing layers and gloves have not been completely evaluated by HED . The key element being evaluated by HED is the factor for clothing. The value used for respiratory protection is based on the *NIOSH Respirator Decision Logic* and the value for gloves is in the range that OSHA and NIOSH often use.

- Flagging aerial applications with engineering control was calculated with the baseline exposure units and a protection factor (PF) of 98%. HED believes the more common engineering control would be to install a global positioning system to replace the flagger, thus eliminating this exposure scenario.

- No DFR study was conducted on cotton, therefore data from the tomato study in GA and CA were averaged and used as a default dissipation rate. This entailed averaging the slope of the two dissipations and the y-intercepts. This was suggested by the Science Advisory Committee on Exposure as a surrogate range finding dissipation rate, conservative in that the values are from cotton areas and the R^2 for these dissipations suggested a fair regression quality. Another surrogate method that uses the worst case dissipation rate as surrogate, would have used an R^2 of low quality (below 0.70).

- Because of the insufficient number of data points for fixed-wing, open-cockpit aircraft in the PHED, these data are not used either as a subset, or in combination with data from fixed-wing, closed-cockpit aircraft. Exposure from open-cockpit planes is considered qualitatively to present a potentially greater exposure to applicators than closed-cockpit, but the quantitative extent remains a data gap until empirical data are generated. If the estimated MOE for application of a given pesticide using closed-cockpit data from PHED or a pesticide-specific exposure study is an order of magnitude larger than the uncertainty factor (i.e., the acceptable MOE), then the use of an open-cockpit fixed-wing aircraft for application also should be acceptable[6].

iii. Incident Reports

Insert incident report here.

iv. Data Requirements

Some areas of occupational handler exposure to methamidophos would be better characterized in this chapter with more data. Areas of data needs are as follows:

- Chemical-specific exposure studies, data on typical use and types of mixing and loading carried out for application equipment.

- Information on types of packaging available to certified agriculture applicators.

- Bayer Corp. and Valent are members of the Agriculture Re-entry Task Force (ARTF). This task force united in response to a data-call-in made by the EPA. Studies have been conducted on postapplication pesticide residues and transfer coefficients associated with agricultural field duties. Submission and review of the ARTF study data could change the occupational risk assessment results for methamidophos.

References

1. Federal Register Vol. 62, No. 246, pp 67071-67072. December 23,1997.

2. HED Science Advisory Council for Exposure, Policy.007, “Use of Values from the PHED Surrogate Table and Chemical-Specific Data.” Health Effects Division, Office of Pesticide Programs. January, 1999.

3. PHED Surrogate Exposure Guide, V1.1. Health Effects Division, Office of Pesticide Program. August, 1998.”

4. HED Science Advisory Council for Exposure, Policy 005, "Use of PHED data for Application by Rotary Wing Aircraft." Health Effect Division, Office of Pesticide Programs. May, 1998.

5. HED Science Advisory Council for Exposure, Policy 003, "Agricultural Default Transfer Coefficients" Health Effect Division, Office of Pesticide Programs. May, 1998.

6. HED Science Advisory Council for Exposure, Policy 006, "The Use of PHED Aerial Application Data" Health Effect Division, Office of Pesticide Programs. August, 1998.

Reviewers: M. Collantes (8/03/99); S. Weiss (8/03/99); D. Vogel (8/03/99).

Table 9:Numerical Inputs for Occupational Handler Exposure to Methamidophos.

Exposure Scenario	Application Rate[a] (lb ai/A)	Treated Area[b] (A/day)	Baseline Unit Values		PPE Mitigation Unit Values[e]		Engineering Control Unit Values[f]	
			Dermal[c] (mg ai/ lb handled)	Inhalation[d] (μg ai/ lb ai handled)	Dermal (mg ai/ lb handled)	Inhalation (μg ai/ lb ai handled)	Dermal (mg ai/ lb handled)	Inhalation (μg ai/ lb ai handled)
Mixer/Loader Exposure								
(1a) Mixing/Loading Aerial/Chemigation	1	350	2.9	1.2	0.017	0.24	0.0086	0.083
(1b) Mixing/Loading Groundboom	1	80	2.9	1.2	0.017	0.24	0.0086	0.083
Applicator Exposure								
(2) Applying Spray with Fixed Wing Aircraft	1	350	NA	NA	NA	NA	0.0050	0.068
(3) Applying Spray with Helicopter	1	350	NA	NA	NA	NA	NS	NS
(4) Applying spray with Groundboom	1	80	0.014	0.74	0.011	0.15	0.0051	0.043
Flagger Exposure								
(5) Flagging Aerial Spray Applications	1	350	0.011	0.35	0.0106	0.070	0.00022	0.007

NA: Not applicable to scenario due to nature of task or equipment (i.e., HED assumes that all agricultural aerial applications are made with enclosed cab aircraft). NS: Not sufficient data to determine potential exposure to applicator.

a Maximum application rates are values found in Bayer and Valent Monitor 4 labels. The formulations are 4 pounds active ingredient per gallon of formulation, based on the labels.

b Amounts of acreage treated per day are from the HED estimates of acreage that could be treated in a single day for each exposure scenario of concern.

c Baseline dermal unit exposure represents long pants, long sleeved shirt, no gloves, open mixing/loading, open cab tractor for groundboom applications, and open flagging.

d Baseline inhalation unit exposure represents no respirator.

e PPE: Scenario 1a and 1b - open mixing/loading, double layer of clothing, chemical resistant gloves (dermal), and a dust/mist respirator (inhalation) (i.e., 80% protection factor); Scenario 2 and 3 - no PPE data available; Scenario 4 - open cab, double layer clothing, chemical resistant gloves (dermal), and a dust/mist respirator (inhalation) (i.e., 80% protection factor); Scenario 5 - double layer of clothing, no gloves, and dust/mist respirator (inhalation) (i.e., 80% protection factor).

f Engineering controls entails closed mixing and loading systems (PHED mixer/loader also wearing chemical resistant glove data), enclosed tractor or airplane cabs and use of an enclosed vehicle for the flagger.

Table 10: Baseline Clothing Scenario Exposure and Risks for Occupational Handlers of Methamidophos, Short- and Intermediate-Term.

(No.) Exposure Scenario	Daily Exposure (mg/day)[a]		Absorbed Daily Dose (mg/kg/day)[b]		Separate MOEs[c]		Combined MOEs[d]
	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader							
(1a)Mixing/Loading Aerial/Chemigation	1000	0.42	15	0.006	0.05	45	0.052
(1b) Mixing/Loading Groundboom	230	0.096	3.3	0.0014	0.23	200	0.23
Applicator							
(2) Applying Spray with Fixed Wing Aircraft	NA	NA	NA	NA	NA	NA	NA
(3) Applying Spray with Helicopter	NA	NA	NA	NA	NA	NA	NA
(4) Applying spray with Groundboom	1.1	0.059	0.016	0.00085	47	320	41
Flagger							
(5) Flagging Aerial Spray Applications	3.9	0.12	0.055	0.0018	14	150	13

NA: Not applicable due to equipment used. HED believes all agricultural aircraft are enclosed cab, helicopter PHED data insufficient for evaluation.

a Daily Exposure (mg/day) = Application Rate (lb ai/A) * Treated Area (A/day) * Unit Exposure Value (mg or μg ai exposure/ lb ai handled) *[1mg/1000μg (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) ÷ Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) ÷ Absorbed Daily Dose (mg/kg/day). Where $NOAEL_{dermal}$= 0.75 mg/kg/day and $NOAEL_{inhalation}$= 0.27 mg/kg/day.

d Combined MOEs = $$\frac{1}{\left(\frac{1}{\mathrm{MOE}derm} + \frac{1}{\mathrm{MOE}inhal}\right)}$$

Table 11: PPE Mitigation Scenario Exposure and Risks for Occupational Handlers of Methamidophos, Short- and Intermediate-Term.

(No.) Exposure Scenario	Daily Exposure (mg/day)[a]		Absorbed Daily Dose (mg/kg/day)[b]		Separate MOEs[c]		Combined MOEs[d]
	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader							
(1a)Mixing/Loading Aerial/Chemigation	6.0	0.084	0.085	0.0012	8.8	230	8
(1b) Mixing/Loading Groundboom	1.4	0.019	0.019	0.00027	39	980	37
Applicator							
(2) Applying Spray with Fixed Wing Aircraft	NA	NA	NA	NA	NA	NA	NA
(3) Applying Spray with Helicopter	NA	NA	NA	NA	NA	NA	NA
(4) Applying spray with Groundboom	0.88	0.012	0.013	0.00017	60	1600	58
Flagger							
(5) Flagging Aerial Spray Applications	3.7	0.025	0.053	0.00035	14	770	14

NA: Not applicable due to equipment used. HED believes all agricultural aircraft are enclosed cab.

a Daily Exposure (mg/day) = Application Rate (lb ai/A) * Treated Area (A/day) * Unit Exposure Value (mg or μg ai exposure/ lb ai handled) *[1mg/1000μg (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) ÷ Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) ÷ Absorbed Daily Dose (mg/kg/day). Where $NOAEL_{dermal}$= 0.75 mg/kg/day and $NOAEL_{inhalation}$= 0.27 mg/kg/day.

d Combined MOEs = $\dfrac{1}{\left(\dfrac{1}{\text{MOE}derm} + \dfrac{1}{\text{MOE}inhal}\right)}$

Table 12: Engineering Controls Scenario Exposure and Risks for Occupational Handlers of Methamidophos, Short- and Intermediate-Term.

(No.) Exposure Scenario	Daily Exposure (mg/day)[a]		Absorbed Daily Dose (mg/kg/day)[b]		Separate MOEs[c]		Combined MOEs[d]
	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	
Mixer/Loader							
(1a)Mixing/Loading Aerial/Chemigation	3.0	0.029	0.043	0.00042	17	650	17
(1b) Mixing/Loading Groundboom	0.69	0.0066	0.0098	0.000095	76	2800	74
Applicator							
(2) Applying Spray with Fixed Wing Aircraft	1.8	0.024	0.025	0.00034	30	790	29
(3) Applying Spray with Helicopter	NS	NS	NS	NS	NS	NS	NS
(4) Applying spray with Groundboom	0.41	0.0034	0.0058	0.000049	130	5500	130
Flagger							
(5) Flagging Aerial Spray Applications	0.077	0.0025	0.0011	0.000035	681	7700	630

NA: Not applicable due to task or equipment type (i.e., Flagger would be replaced by global positioning system for engineering control therefore no human exposure)

a Daily Exposure (mg/day) = Application Rate (lb ai/A) * Treated Area (A/day) * Unit Exposure Value (mg or μg ai exposure/ lb ai handled) *[1mg/1000μg (conversion factor if necessary)].

b Absorbed Daily Dose (mg/kg/day) = Daily Exposure (mg/day) * Absorption (1) ÷ Body Weight (70kg).

c MOE (unitless) = NOAEL (mg/kg/day) ÷ Absorbed Daily Dose (mg/kg/day). Where $NOAEL_{dermal}$= 0.75 mg/kg/day and $NOAEL_{inhalation}$= 0.27 mg/kg/day.

d Combined MOEs = $\dfrac{1}{\left(\dfrac{1}{\text{MOE}derm} + \dfrac{1}{\text{MOE}inhal}\right)}$

Table 13: Exposure Scenario Descriptions for the Use of Methamidophos

(Number) Exposure Scenario	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixer/Loader Descriptors			
(1a) Mixing/Loading of Liquid Formulation for Aerial Application and Chemigation (i.e., sprinkler irrigation	PHED V1.1	350 acres.	**Baseline:** Hands, dermal, and inhalation - acceptable grades. Hands = 53 replicates; dermal = 75 to 122 replicates; inhalation = 85 replicates. High confidence in hands, dermal, and inhalation data. Single layer, no gloves for dermal. **PPE:** Hands, dermal, and inhalation - acceptable grades. Hands = 59 replicates; dermal = 72 to 122 replicates; inhalation = 85 replicates. High confidence in hands, dermal, and inhalation data. Maximum PPE values calculated from PHED data using a 50% protection factor for the addition of coveralls; a 80% protection factor was used for inhalation PPE. Double layer, gloves for dermal. **Engineering Controls (closed mixing)** Hands, dermal, and inhalation - acceptable grades. Hands = 31 replicates; dermal = 16 to 22 replicates; inhalation = 27 replicates. High confidence in hands, dermal, and inhalation data. Single layer, **gloves** for dermal.
(1b) Mixing/Loading of Liquid Formulation for Groundboom Applications	PHED V1.1	80 acres.	
Applicator Descriptors			
(2) Applying Sprays with a Fixed-Wing Aircraft	PHED V1.1	350 acres.	**Baseline:** Not feasible, see Characterization Section 4.c.i **PPE:** Not Feasible **Engineering Controls (enclosed cockpit):** "Best Available" grades: Hands = acceptable grades; dermal and inhalation = ABC grades. Hands = 34 replicates; dermal = 24 to 48 replicates; inhalation = 23 replicates. Medium confidence in hands, dermal and inhalation data. Single layer, no gloves for dermal.
(3) Applying Sprays with Helicopter	PHED V1.1	350 acres.	**Baseline:** Not Feasible **PPE:** Not Feasible **Engineering Controls (closed cockpit):** *Aerial application in this assessment is assumed to be by fixed wing aircraft.*
(4) Applying Sprays with Groundboom Equipment	PHED V1.1	80 acres.	**Baseline:** Hands, dermal, and inhalation = acceptable grades. Hands = 29 replicates; dermal = 32 to 42 replicates; inhalation = 22 replicates. High confidence in hands, dermal and inhalation data. Single layer, no gloves for dermal. **PPE:** Hands = ABC grades; dermal, and inhalation = acceptable grades. Hands = 21 replicates; dermal = 32 to 42 replicates; inhalation = 22 replicates. High confidence in hands, dermal and inhalation data. Maximum PPE values calculated from PHED data using a 50% protection factor for the addition of coveralls; a 80% protection factor was used for inhalation PPE. Double layer, no gloves for dermal. **Engineering Controls (closed cab):** Hands = ABC grades; dermal = ABC grades; inhalation = acceptable grades. Hands = 16 replicates; dermal = 20 to 31 replicates; inhalation = 16 replicates. Medium confidence in hands and dermal; high confidence in inhalation. Single layer, no gloves for dermal.

Table 13: Exposure Scenario Descriptions for the Use of Methamidophos			
(Number) Exposure Scenario	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Flagger Descriptors			
(5) Flagging Aerial Spray Applications	PHED V1.1	350 acres.	**Baseline:** Hands, dermal, and inhalation = acceptable grades. Hands = 16 replicates; dermal = 16 to 18 replicates; inhalation =18 replicates. High confidence in hands, dermal and inhalation data. Single layer, no gloves for dermal. **PPE:** Hands, dermal, and inhalation = acceptable grades. Hands = 16 replicates; dermal = 16 to 18 replicates; inhalation = 18 replicates. High confidence in hands, dermal, and inhalation data. Maximum PPE values calculated from PHED data using a 50% protection factor (PF) on non-hand dermal data to simulate the use of coveralls (double layer) and a 80% PF on inhalation data to simulate the use of a respirator. No gloves for dermal. **Engineering Controls:** Same as Baseline values, using a 98%protection factor to account for enclosed vehicle engineering control.

Table 14: Estimates of Postapplication Exposure and Risk to Workers Dig/Harvest by Hand (TC = 10,000 cm^2/hr) Following Applications of Methamidophos to Potatoes (1.0 lb ai/acre).

data	KS			MI			WA		
	DFR (1lb ai/A)[b] $\mu g/cm^2$	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] $\mu g/cm^2$**	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] $\mu g/cm^2$**	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**
0	0.4839	0.5531	1	0.2668	0.3049	2	0.3075	0.352	2
1	0.3894	0.4450	2	0.1655	0.1891	4	0.2316	0.265	3
2	0.3133	0.3580	2	0.1026	0.1173	6	0.1744	0.199	4
3	0.2520	0.2880	3	0.06367	0.07276	10	0.1313	0.150	5
4	0.2028	0.2318	3	0.03949	0.04513	17	0.09891	0.113	7
5	0.1632	0.1865	4	0.02449	0.02799	27	0.07449	0.0851	9
6	0.1313	0.150	5	0.01519	0.01736	43	0.05610	0.0641	12
7	0.1056	0.1207	6	0.009422	0.01077	70	0.04224	0.0483	16
8	0.08497	0.09711	8	**0.005844**	**0.00668**	**110**	0.03181	0.0364	21
9	0.06837	0.07813	10	-	-	-	0.02396	0.0274	27
10	0.05501	0.06286	12	-	-	-	0.01804	0.0206	36
11	0.04426	0.05058	15	-	-	-	0.01359	0.0155	48
12	0.03561	0.04069	18	-	-	-	0.010232	0.0117	64
13	0.02865	0.03274	23	-	-	-	0.007706	0.00881	85
14	0.02305	0.02634	28	-	-	-	**0.005803**	**0.00663**	**110**
15	0.01855	0.02119	35	-	-	-	-	-	-
16	0.01492	0.01705	44	-	-	-	-	-	-
17	0.01200	0.01372	55	-	-	-	-	-	-
18	0.009658	0.01104	68	-	-	-	-	-	-
19	0.007771	0.008881	84	-	-	-	-	-	-
20	**0.006252**	**0.007145**	**105**	-	-	-	-	-	-

NOTE: Values rounded; calculations are based on spreadsheet analyses.

a Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

b Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

c Harvest Exposure (mg/kg/day) = DFR ($\mu g/cm^2$) * Transfer Coefficient (10,000 cm^2/hr for potato harvest) * (8 hr/work day) * (1mg/1000 μg conversion factor) ÷70 kg Body Weight.

d Dermal Short- and Intermediate-term MOE = $NOAEL_{dermal}$/ Exposure; where $NOAEL_{dermal}$ = 0.75 mg/kg/day. MOE of 100 is an acceptable margin of exposure.

Table 15: Estimates of Postapplication Exposure and Risk to Workers Harvest by Hand (TC = 10,000 cm^2/hr) Following Applications of Methamidophos to Tomatoes (1.0 lb ai/acre).

DATA	FL			GA			CA		
	DFR (1lb ai/A) $\mu g/cm^2$	**Harvest Exposure (mg/kg/day)**	**MOE**	**DFR (1lb ai/A) $\mu g/cm^2$**	**Harvest Exposure (mg/kg/day)**	**MOE**	**DFR (1lb ai/A) $\mu g/cm^2$**	**Harvest Exposure (mg/kg/day)**	**MOE**
0	0.4657	0.532	1	0.5438	0.622	1	0.2646	0.302	2
1	0.4177	0.477	2	0.4269	0.488	2	0.2104	0.241	3
2	0.3746	0.428	2	0.3351	0.383	2	0.1673	0.191	4
3	0.3360	0.384	2	0.2631	0.301	2	0.1331	0.152	5
4	0.3013	0.344	2	0.2065	0.236	3	0.1058	0.121	6
5	0.2703	0.309	2	0.1621	0.185	4	0.08415	0.0962	8
6	0.2424	0.277	3	0.1273	0.145	5	0.06692	0.0765	10
7	0.2174	0.248	3	0.09990	0.114	7	0.05322	0.608	12
8	0.1950	0.223	3	0.07842	0.0896	8	0.04232	0.0484	16
9	0.1749	0.200	4	0.06156	0.0704	11	0.03366	0.0385	19
10	0.1569	0.179	4	0.04832	0.0552	14	0.02676	0.0306	25
11	0.1407	0.161	5	0.03793	0.0434	17	0.02128	0.0243	31
12	0.1262	0.144	5	0.02978	0.0340	22	0.01693	0.0193	39
13	0.1132	0.129	6	0.02338	0.0267	28	0.01346	0.0154	49
14	0.1015	0.116	6	0.01835	0.0210	36	0.01070	0.0122	61
15	0.09103	0.104	7	0.01440	0.0165	46	0.008512	0.00973	77
16	0.08165	0.0933	8	0.01131	0.0129	58	0.006769	0.00774	97
17	0.07323	0.0837	9	0.008877	0.0101	74	**0.005383**	**0.00615**	**120**
18	0.06568	0.0751	10	0.006968	0.00796	94	-	-	-
19	0.05891	0.0673	11	**0.005470**	**0.00625**	**120**	-	-	-
20	0.05283	0.0604	12	-	-	-	-	-	-
21	0.04738	0.0542	14	-	-	-	-	-	-
22	0.04250	0.0486	15	-	-	-	-	-	-

DATA	FL			GA			CA		
	DFR (1lb ai/A) $\mu g/cm^2$	**Harvest Exposure (mg/kg/day)**	**MOE**	**DFR (1lb ai/A) $\mu g/cm^2$**	**Harvest Exposure (mg/kg/day)**	**MOE**	**DFR (1lb ai/A) $\mu g/cm^2$**	**Harvest Exposure (mg/kg/day)**	**MOE**
23	0.03812	0.0436	17	-	-	-	-	-	-
24	0.03419	0.0391	19	-	-	-	-	-	-
25	0.03066	0.0350	21	-	-	-	-	-	-
26	0.02750	0.0314	24	-	-	-	-	-	-
27	0.02466	0.0282	27	-	-	-	-	-	-
28	0.02212	0.0253	30	-	-	-	-	-	-
29	0.01984	0.0227	33	-	-	-	-	-	-
30	0.01780	0.0203	37	-	-	-	-	-	-
31	0.01596	0.0182	41	-	-	-	-	-	-
32	0.01431	0.0164	46	-	-	-	-	-	-
33	0.01284	0.0147	51	-	-	-	-	-	-
34	0.01151	0.0132	57	-	-	-	-	-	-
35	0.01033	0.0118	64	-	-	-	-	-	-
36	0.009263	0.0106	71	-	-	-	-	-	-
37	0.008308	0.00949	79	-	-	-	-	-	-
38	0.007451	0.00852	88	-	-	-	-	-	-
39	0.006683	0.00764	98	-	-	-	-	-	-
40	0.005994	0.00685	**110**	-	-	-	-	-	-

NOTE: Values rounded; calculations are based on spreadsheet analyses.

a Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

b Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

c Harvest Exposure (mg/kg/day) = DFR ($\mu g/cm^2$) * Transfer Coefficient (10,000 cm^2/hr for tomato harvest) * (8 hr/work day) * (1mg/1000 μg conversion factor) ÷70 kg Body Weight.

d Dermal Short- and Intermediate-term MOE = $NOAEL_{dermal}$/ Exposure; where $NOAEL_{dermal}$ = 0.75 mg/kg/day. MOE of 100 is acceptable margin of exposure.

Table 16: Estimates of Postapplication Exposure and Risk to Workers Sorting and Packing (Tc = 2,500 cm^2/hr) Following Applications of Methamidophos to Potatoes (1.0 lb ai/acre).

DAT[a]	KS			MI			WA		
	DFR (1lb ai/A)[b] μg/cm^2	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] μg/cm^2**	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] μg/cm^2**	**Harvest Exposure[c] (mg/kg/day)**	**MOE[d]**
0	0.4839	0.138	5	0.2668	0.0762	10	0.3075	0.0879	9
1	0.3894	0.111	7	0.1655	0.0473	16	0.2316	0.0662	11
2	0.3133	0.0895	8	0.1026	0.0293	26	0.1744	0.0498	15
3	0.2520	0.0720	10	0.06367	0.0182	41	0.1313	0.0375	20
4	0.2028	0.0579	13	0.03949	0.0113	66	0.09891	0.0283	27
5	0.1632	0.0466	16	**0.02449**	**0.0070**	**107**	0.07449	0.0213	35
6	0.1313	0.0375	20	-	-	-	0.05610	0.0160	47
7	0.1056	0.0302	25	-	-	-	0.04224	0.0121	62
8	0.08497	0.0243	31	-	-	-	0.03181	0.00909	83
9	0.06837	0.0195	38	-	-	-	**0.02396**	**0.00685**	**110**
10	0.05501	0.0157	48	-	-	-	-	-	-
11	0.04426	0.0126	59	-	-	-	-	-	-
12	0.03561	0.0102	74	-	-	-	-	-	-
13	0.02865	0.00819	92	-	-	-	-	-	-
14	**0.02305**	**0.00659**	**114**	-	-	-	-	-	-

NOTE: Values rounded; calculations are based on spreadsheet analyses.

a Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

b Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA.

c Harvest Exposure (mg/kg/day) = DFR (μg/cm^2) * Transfer Coefficient (2,500 cm^2/hr for potato sorting/packing) * (8 hr/work day) * (1mg/1000 μg conversion factor) ÷70 kg Body Weight.

d Dermal Short- and Intermediate-term MOE = NOAEL$_{dermal}$/ Exposure; where NOAEL$_{dermal}$ = 0.75 mg/kg/day. MOE of 100 is an acceptable margin of exposure.

Table 17: Estimates of Postapplication Exposure and Risk to Workers Harvest by Stake/Tie/Scout/Irrigate (Tc = 4,000 cm^2/hr) Following Applications of Methamidophos to Tomatoes (1.0 lb ai/acre).

DAT[a]	FL			GA			CA		
	DFR (1lb ai/A)[b] $\mu g/cm^2$	Stake/Tie Exposure[c] (mg/kg/day)	MOE[d]	DFR (1lb ai/A)[b] $\mu g/cm^2$	Stake/TieExposure[c] (mg/kg/day)	MOE[d]	DFR (1lb ai/A)[b] $\mu g/cm^2$	Stake/Tie Exposure[c] (mg/kg/day)	MOE[d]
0	0.4657	0.213	4	0.5438	0.249	3	0.2646	0.121	6
1	0.4177	0.191	4	0.4269	0.195	4	0.2104	0.0962	8
2	0.3746	0.171	4	0.3351	0.153	5	0.1673	0.0765	10
3	0.3360	0.154	5	0.2631	0.120	6	0.1331	0.0608	12
4	0.3013	0.138	5	0.2065	0.0944	8	0.1058	0.0484	16
5	0.2703	0.124	6	0.1621	0.0741	10	0.08415	0.0385	19
6	0.2424	0.111	7	0.1273	0.0582	13	0.06692	0.0306	25
7	0.2174	0.0994	8	0.09990	0.0457	16	0.05322	0.0243	31
8	0.1950	0.0891	8	0.07842	0.0358	21	0.04232	0.0193	39
9	0.1749	0.0799	9	0.06156	0.0281	27	0.03366	0.0154	49
10	0.1569	0.0717	10	0.04832	0.0221	34	0.02676	0.0122	61
11	0.1407	0.0643	12	0.03793	0.0173	43	0.02128	0.0097	77
12	0.1262	0.0577	13	0.02978	0.0136	55	0.01693	0.0077	97
13	0.1132	0.0517	14	0.02338	0.0107	70	**0.01346**	**0.0062**	**122**
14	0.1015	0.0464	16	0.01835	0.0084	89	-	-	-
15	0.09103	0.0416	18	**0.01440**	**0.0066**	**114**	-	-	-
16	0.08165	0.0373	20	-	-	-	-	-	-
17	0.07323	0.0335	22	-	-	-	-	-	-
18	0.06568	0.0300	25	-	-	-	-	-	-
19	0.05891	0.0269	28	-	-	-	-	-	-
20	0.05283	0.0242	31	-	-	-	-	-	-
21	0.04738	0.0217	35	-	-	-	-	-	-
22	0.04250	0.0194	39	-	-	-	-	-	-

DAT[a]	FL			GA			CA		
	DFR (1lb ai/A)[b] μg/cm^2	**Stake/Tie Exposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] μg/cm^2**	**Stake/TieExposure[c] (mg/kg/day)**	**MOE[d]**	**DFR (1lb ai/A)[b] μg/cm^2**	**Stake/Tie Exposure[c] (mg/kg/day)**	**MOE[d]**
23	0.03812	0.0174	43	-	-	-	-	-	-
24	0.03419	0.0156	48	-	-	-	-	-	-
25	0.03066	0.0140	54	-	-	-	-	-	-
26	0.02750	0.0126	60	-	-	-	-	-	-
27	0.02466	0.0113	67	-	-	-	-	-	-
28	0.02212	0.0101	74	-	-	-	-	-	-
29	0.01984	0.0091	83	-	-	-	-	-	-
30	0.01780	0.0081	92	-	-	-	-	-	-
31	**0.01596**	**0.0073**	**103**	-	-	-	-	-	-

NOTE: Values rounded; calculations are based on spreadsheet analyses.

a Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

b Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA for application of 1 lb ai per acre..

c Stake/Tie Exposure (mg/kg/day) = DFR (μg/cm^2) * Transfer Coefficient (4,000 cm^2/hr for tomato Scout/tie/stake/irrigate tomatoes) * (8 hr/work day) * (1mg/1000 μg conversion factor) ÷70 kg Body Weight.

d Dermal Short- and Intermediate-term MOE = NOAEL$_{dermal}$/ Exposure; where NOAEL$_{dermal}$ = 0.75 mg/kg/day. MOE of 100 is acceptable margin of exposure.

Table 18: REIs calculated for Cotton dissipation using average slope from GA and CA tomatoes and average y-intercept.

DAT[A]	**Cotton (Tc = 1000)**			**Cotton (Tc = 4000)**	
	DFR (1lb ai/A) μg/cm^2	**Early Season Scouting Exposure (mg/kg/day)**	**MOE**	**Late Season Scouting Exposure (mg/kg/day)**	**MOE**
0	0.4042	0.0462	16	0.185	4
1	0.3192	0.0365	21	0.146	5
2	0.2521	0.0288	26	0.115	7
3	0.1991	0.0228	33	0.0910	8
4	0.1573	0.0180	42	0.0719	10
5	0.1242	0.0142	53	0.0568	13
6	0.09809	0.0112	67	0.0448	17
7	0.07747	0.00885	85	0.0354	21
8	**0.06119**	**0.00699**	**110**	0.0280	27
9	0.04832	-	-	0.0221	34
10	0.03816	-	-	0.0174	43
11	0.03014	-	-	0.0138	54
12	0.02381	-	-	0.0109	69
13	0.01880	-	-	0.0086	87
14	**0.01485**	**-**	**-**	**0.0068**	**110**

NOTE: Values rounded; calculations are based on spreadsheet analyses.

a Days After Treatment (DAT). Workers wearing long pants, long sleeved shirts and no gloves.

b Dislodgeable Foliar Residue (DFR) calculated by Versar using Excel® Spreadsheet and ANOVA. Dissipation from average of CA and GA slope and intercepts on Tomatoes.

c Scouting Exposure (mg/kg/day) = DFR (μg/cm^2) * Transfer Coefficient (1000 or 4000 cm^2/hr for cotton scouting) * (8 hr/work day) * (1mg/1000 μg conversion factor) ÷70 kg Body Weight.

d Dermal Short- and Intermediate-term MOE = $NOAEL_{dermal}$/ Exposure; where $NOAEL_{dermal}$ = 0.75 mg/kg/day. MOE of 100 is an acceptable margin of exposure.